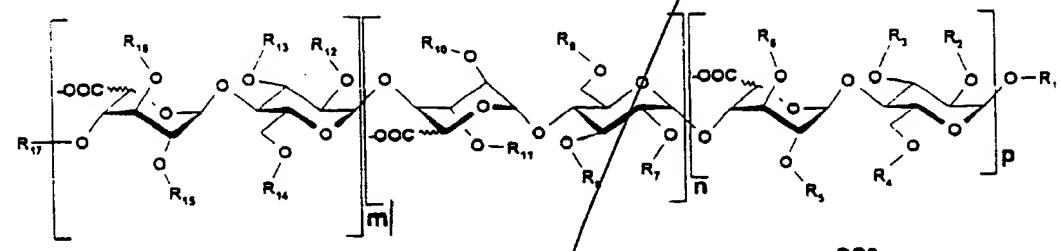
CLAIMS

1. Synthetic polysaccharide containing from 8 to 24 monosaccharide units formed by a sequence of disaccharides formed from a uronic acid and from a hexose, the said polysaccharide being characterized in that all its hydroxyl groups are etherified with a (C_1-C_6)alkyl group or esterified in the form of a sulpho group, each disaccharide being at least monoetherified; as well as its salts.

2. Salt formed from an anion and a cation, the anion having the formula:



(I)

in which

- the wavy line indicates either a bond below or above the plane of the pyranose ring;
- R_1, R_6, R_{11} and R_{16} are a (C_1-C_6)alkyl;
- R_2, R_3, R_4, R_5, R_7, R_8, R_9, R_{10}, R_{12}, R_{13}, R_{14}, R_{15} and R_{17} are a (C_1-C_6)alkyl or an SO_3^- group;
- m, n and p are such that the sum m + n + p is greater than or equal to 4 and less than or equal to 12, one or two of the three being able to be zero;

the cation being a pharmaceutically acceptable monovalent cation,

as well as the corresponding acid.

3. Salt according to Claim 2 in which the cation is selected from the cations of alkali metals, in particular sodium and potassium.

4. Salt according to one of Claims 2 or 3 in which the alkyls are methyls, as well as the corresponding acid.

5. Salt according to one of Claims 2 or 3 in which n and p are equal to zero, as well as the corresponding acid.

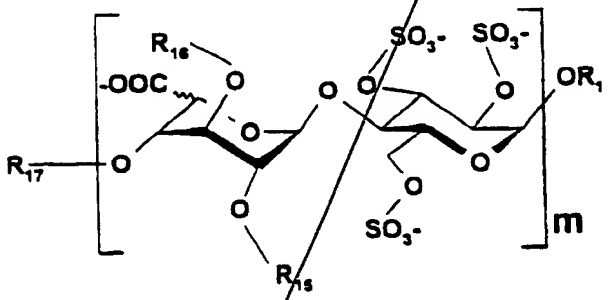
6. Salt according to one of Claims 2 or 3 in which n and p are equal to zero and m is 4 to 10, as well as the corresponding acid.

7. Salt according to one of Claims 2 or 3 in which n and p are equal to zero, m is 4 to 10; at least one of the substituents R_{12}, R_{13}, R_{14} and R_{15} is a sulphate group; R_1, R_{16} and R_{17} being as defined for (I), as well as the corresponding acid.

8. Salt according to one of Claims 2 or 3 in which n and p are equal to zero, m is 4 to 10; at least two of the substituents R_{12}, R_{13}, R_{14} and R_{15} are a sulphate group; R_1, R_{16} and R_{17} being such as defined for (I), as well as the corresponding acid.

9. Salt according to one of Claims 2 or 3, in which n and p are equal to zero, m is 4 to 10; at least three of the substituents R_{12}, R_{13}, R_{14} and R_{15} are a sulphate group; R_1, R_{16} and R_{17} being such as defined for (I), as well as the corresponding acid.

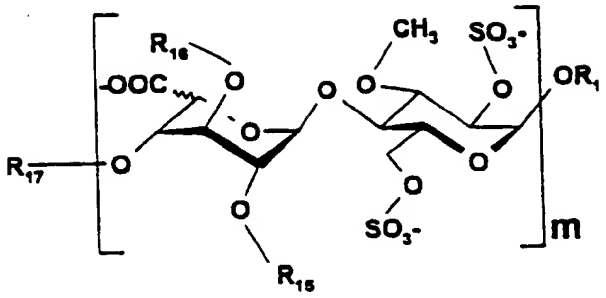
10. Salt according to Claim 2 or 3 whose anion has the formula (I.1):



(I.1)

in which m is 4 to 10; R_1, R_{15}, R_{16} and R_{17} are such as defined for (I), each uronic acid being either an iduronic or glucuronic acid, as well as the corresponding acid.

11. Salt according to one of Claims 2 or 3 whose anion has the formula (I.2):

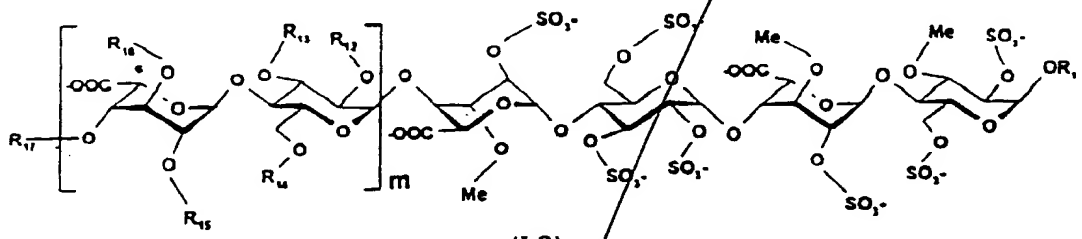


(I.2)

Sub a2

in which m is 4 to 10; R_1, R_{15}, R_{16} and R_{17} are such as defined for (I), each uronic acid being either an iduronic or glucuronic acid, as well as the corresponding acid.

12. Salt according to Claims 2 or 3 whose anion has the formula (I.3):



(I.3)

in which m is 2 or 3; R_1, R_{12}, R_{13}, R_{14}, R_{15}, R_{16} and R_{17} are such as defined for (I), each uronic acid being either an iduronic or glucuronic acid, as well as the corresponding acid.

13. Salt according to Claim 12 in which R_1 is a methyl, R_{13} in position 3 of the glucose is a methyl, R_{12} in position 2 and R_{14} in position 6 of the glucose are an SO_3^- and R_{16} in position 3 of the iduronic or glucuronic unit is a methyl, m being equal to 2 or 3.

14. Polysaccharide chosen from amongst:

methyl (1-4)-*O*-(2,3-di-*O*-methyl-4-*O*-sulpho-α-L-ido-pyranosyluronic acid)-[(1-4)-*O*-(2,3,6-tri-*O*-sulpho-α-D-glucopyranosyl)-(1-4)-*O*-(2,3-di-*O*-methyl-α-L-idopyranosyluronic

acid)]$_9$-2,3,6-tri-*O*-sulpho-α-D-glucopyranoside, sodium salt,

methyl (1-4)-*O*-(2,3-di-*O*-methyl-4-*O*-sulpho-α-L-ido-pyranosyluronic acid)-[(1-4)-*O*-(2,3,6-tri-*O*-sulpho-α-D-glucopyranosyl)-(1-4)-*O*-(2,3-di-*O*-methyl-α-L-idopyranosyluronic acid)]$_4$-2,3,6-tri-*O*-sulpho-α-D-glucopyranoside, sodium salt,

methyl (1-4)-*O*-(2,3-di-*O*-methyl-4-*O*-sulpho-α-L-ido-pyranosyluronic acid)-[(1-4)-*O*-(2,3,6-tri-*O*-sulpho-α-D-glucopyranosyl)-(1-4)-*O*-(2,3-di-*O*-methyl-α-L-idopyranosyluronic acid)]$_5$-2,3,6-tri-*O*-sulpho-α-D-glucopyranoside, sodium salt,

methyl (1-4)-*O*-(2,3-di-*O*-methyl-4-*O*-sulpho-α-L-ido-pyranosyluronic acid)-[(1-4)-*O*-(2,3,6-tri-*O*-sulpho-α-D-glucopyranosyl)-(1-4)-*O*-(2,3-di-*O*-methyl-α-L-idopyranosyluronic acid)]$_6$-2,3,6-tri-*O*-sulpho-α-D-glucopyranoside, sodium salt,

methyl (1-4)-*O*-(2,3-di-*O*-methyl-4-*O*-sulpho-α-L-ido-pyranosyluronic acid)-[(1-4)-*O*-(2,3,6-tri-*O*-sulpho-α-D-glucopyranosyl)-(1-4)-*O*-(2,3-di-*O*-methyl-α-L-idopyranosyluronic acid)]$_7$-2,3,6-tri-*O*-sulpho-α-D-glucopyranoside, sodium salt,

methyl (1-4)-*O*-(2,3-di-*O*-methyl-4-*O*-sulpho-α-L-ido-pyranosyluronic acid)-[(1-4)-*O*-(2,3,6-tri-*O*-sulpho-α-D-glucopyranosyl)-(1-4)-*O*-(2,3-di-*O*-methyl-α-L-idopyranosyluronic acid)]$_8$-2,3,6-tri-*O*-sulpho-α-D-glucopyranoside, sodium salt,

methyl (1-4)-*O*-(2,3-di-*O*-methyl-4-*O*-sulpho-β-D-gluco-pyranosyluronic acid)-[(1-4)-*O*-(2,3,6-tri-*O*-sulpho-α-D-glucopyranosyl)-(1-4)-*O*-(2,3-di-*O*-methyl-β-D-glucopyrano-syluronic acid)]$_4$-2,3,6-tri-*O*-sulpho-α-D-glucopyranoside, sodium salt,

methyl (1-4)-*O*-(2,3-di-*O*-methyl-4-*O*-sulpho-β-D-gluco-pyranosyluronic acid)-[(1-4)-*O*-(2,3,6-tri-*O*-sulpho-α-D-glucopyranosyl)-(1-4)-*O*-(2,3-di-*O*-methyl-β-D-glucopyrano-syluronic acid)]$_3$-2,3,6-tri-*O*-sulpho-α-D-glucopyranoside, sodium salt,

methyl (1-4)-*O*-(3-*O*-methyl-2,4-di-*O*-sulpho-α-L-ido-

pyranosyluronic acid)-[(1-4)-*O*-(3-*O*-methyl-2,6-di-*O*-sulpho-α-D-glucopyranosyl)-(1-4)-*O*-(3-*O*-methyl-2-*O*-sulpho-α-L-idopyranosyluronic acid)]$_4$-3-*O*-methyl-2,6-di-*O*-sulpho-α-D-glucopyranoside, sodium salt,

methyl (1-4)-*O*-(3-*O*-methyl-2,4-di-*O*-sulpho-α-L-idopyranosyluronic acid)-[(1-4)-*O*-(3-*O*-methyl-2,6-di-*O*-sulpho-α-D-glucopyranosyl)-(1-4)-*O*-(3-*O*-methyl-2-*O*-sulpho-α-L-idopyranosyluronic acid)]$_3$-3-*O*-methyl-2,6-di-*O*-sulpho-α-D-glucopyranoside, sodium salt,

methyl *O*-(3-*O*-methyl-2,4-di-*O*-sulpho-α-L-idopyranosyluronic acid)-[(1-4)-*O*-(3-*O*-methyl-2,6-di-*O*-sulpho-α-D-glucopyranosyl)-(1-4)-*O*-(3-*O*-methyl-2-*O*-sulpho-α-L-idopyranosyluronic acid)(1-4)-]$_5$-3-*O*-methyl-2,6-di-*O*-sulpho-α-D-glucopyranoside, sodium salt,

methyl (1-4)-*O*-(3-*O*-methyl-2,4-di-*O*-sulpho-β-D-glucopyranosyluronic acid)-[(1-4)-*O*-(3-*O*-methyl-2,6-di-*O*-sulpho-α-D-glucopyranosyl)-(1-4)-*O*-(3-*O*-methyl-2-*O*-sulpho-β-D-glucopyranosyluronic acid)]$_4$-3-*O*-methyl-2,6-di-*O*-sulpho-α-D-glucopyranoside, sodium salt,

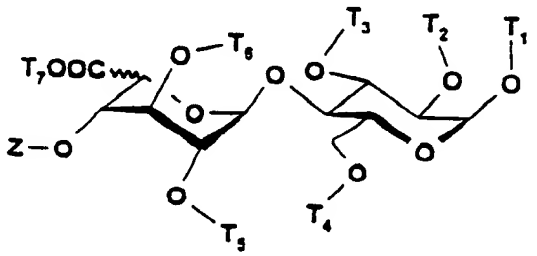
methyl (1-4)-*O*-(3-*O*-methyl-2,4-di-*O*-sulpho-α-L-idopyranosyluronic acid)-[(1-4)-*O*-(3-*O*-methyl-2,6-di-*O*-sulpho-α-D-glucopyranosyl)-(1-4)-*O*-(3-*O*-methyl-2-*O*-sulpho-α-L-idopyranosyluronic acid)]$_2$-*O*-(2,3,6-tri-*O*-sulpho-α-D-glucopyranosyl)-(1-4)-*O*-(3-(1-4)-*O*-methyl-2-*O*-sulpho-α-L-idopyranosyluronic acid)-3-*O*-methyl-2,6-di-*O*-sulpho-α-D-glucopyranoside, sodium salt, and

methyl (1-4)-*O*-(3-*O*-methyl-2,4-di-*O*-sulpho-α-L-idopyranosyluronic acid)-[(1-4)-*O*-(3-*O*-methyl-2,6-di-*O*-sulpho-α-D-glucopyranosyl)-(1-4)-*O*-(3-*O*-methyl-2-*O*-sulpho-α-L-idopyranosyluronic acid)]$_3$-(1-4)-*O*-(2,3,6-tri-*O*-sulpho-α-D-glucopyranosyl)-(1-4)-*O*-(3-*O*-methyl-2-*O*-sulpho-α-L-idopyranosyluronic acid)-3-*O*-methyl-2,6-di-*O*-sulpho-α-D-

glucopyranoside, sodium salt.

15. Process for preparation of the compounds of formula (I) according to Claim 2, characterized in that:

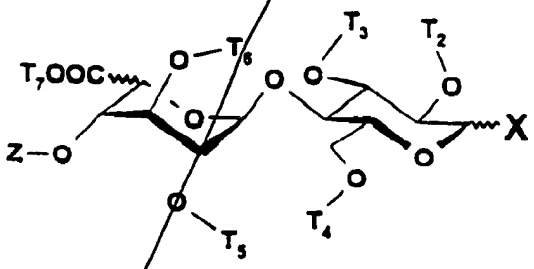
(a) a glycosidic link donor monosaccharide is coupled to a glycosidic link acceptor monosaccharide according to the classical methods of sugar chemistry to obtain an intermediate saccharide synthon of completely protected disaccharide type of formula (A):



(A)

in which the identical or different T_1, T_2, T_3, T_4, T_5, T_6, T_7 and Z substituents are selected from the protective groups used in sugar chemistry as permanent, semi-permanent or temporary protective groups,

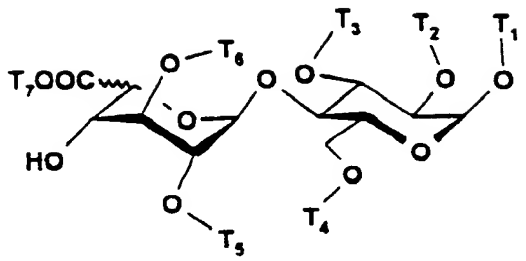
(b) the disaccharide of formula (A) above is modified chemically so as to obtain an intermediate saccharide synthon of glycosidic link donor disaccharide type of formula (B):



(B)

in which T_2 to T_7 and Z are as defined above for (A) and X is an activating group of the anomeric carbon, then

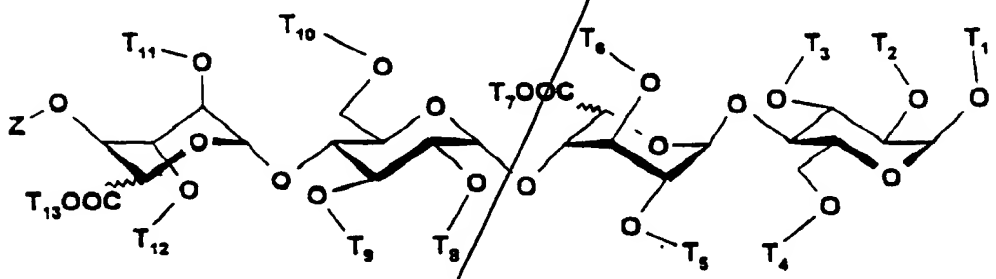
(c) the disaccharide of formula (A) above is modified chemically so as to obtain an intermediate saccharide synthon of glycoside link acceptor disaccharide type of formula (C).



(C)

in which T_1 to T_7 are such as defined above for (A), by selectively eliminating the protective group Z according to classical methods of sugar chemistry, then

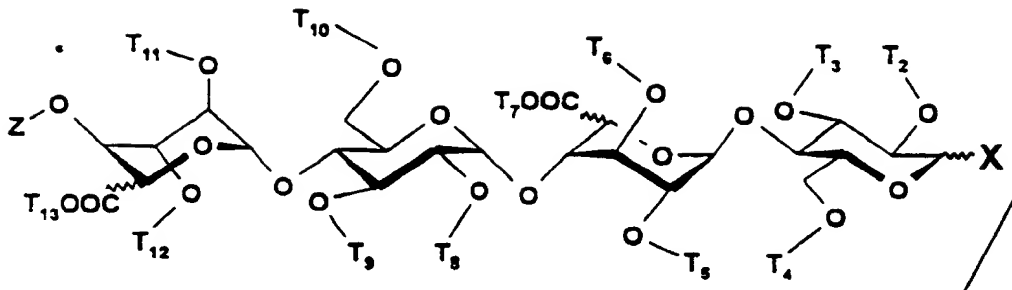
(d) a glycosidic link donor disaccharide of formula (B) obtained above and a glycosidic link acceptor disaccharide of formula (C) obtained above are coupled so as to obtain a completely protected tetrasaccharide of formula (D):



(D)

in which T_1 to T_7 and Z are such as defined above for (A) and T_8, T_9, T_{10}, T_{11}, T_{12} and T_{13} are such as defined for T_2 to T_7 then,

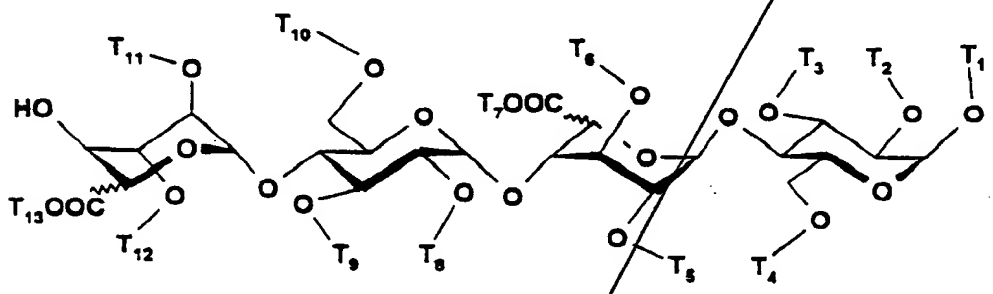
(e) the intermediate saccharide synthon of tetrasaccharide type of formula (D) is then modified chemically so as to obtain an intermediate saccharide synthon of glycosidic link donor tetrasaccharide type of formula (E):



(E)

in which X has the same definition as for (B) and T_2 to T_{13} are such as defined for (D) then,

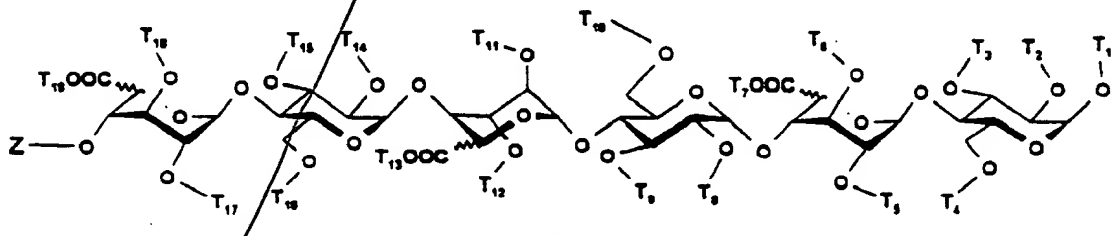
(f) the tetrasaccharide of formula (D) is then selectively deprotected so as to obtain a glycosidic link acceptor tetrasaccharide of formula (F):



(F)

in which T_1 to T_{13} are such as defined above for (D) then,

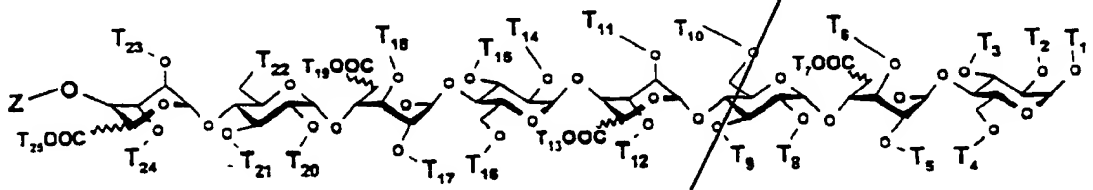
(g) the glycosidic link acceptor tetrasaccharide of formula (F) and a glycosidic link donor disaccharide of formula (B) such as those obtained above are coupled to form an intermediate synthon of completely protected hexasaccharide type of formula (G):



(G)

in which T_1 to T_{13} are such as defined above for (D) and T_{14} to T_{19} are such as defined for T_2 to T_7 for (B);

or else the glycosidic link acceptor tetrasaccharide of formula (F) and a glycosidic link donor tetrasaccharide of formula (E) are coupled so as to obtain a completely protected octasaccharide of formula (H):



(H)

in which T_1 to T_{19} and Z are such as defined previously and T_{20} to T_{25} are such as defined for T_2 to T_7 for (B) then,

(h) the hexasaccharide of formula (G) or the octasaccharide of formula (H) obtained above is modified chemically so as to obtain an intermediate synthon of glycosidic link acceptor hexasaccharide type of formula (G) in which Z is hydrogen or else a glycosidic link acceptor octasaccharide of formula (H) in which Z is hydrogen,

(i) the above deprotection and coupling steps are repeated until the completely protected oligosaccharide having the desired structure is obtained, the glycosyl donor and glycosyl acceptor intermediate saccharide synthons being chosen as a function of the final structure to thus obtain the protected precursor of the desired final polysaccharide of formula (I), in which the nature of the protective substituents determines the position of the alkyl and sulphate groups on the final product (I), and

(j) the deprotection of the alcohol functions which must be sulphated is carried out by eliminating the substituents T_1 to T_{25} which protected the functions in the course of the steps of elaboration of the skeleton, then, finally

(k) the sulphation is carried out to obtain the compounds (I), or one of their salts.

16. Pharmaceutical compositions containing as active principle a polysaccharide or salt according to any one of Claims 1 to 14, in salt form with a pharmaceutically acceptable base or in acid form, in combination or as a mixture with an inert, non-toxic, pharmaceutically acceptable excipient.

17. Pharmaceutical composition according to Claim 16, in the form of dose units, in which the active principle is mixed with at least one pharmaceutical excipient.

18. Composition according to Claim 17 in which each dose unit contains from 0.1 to 100 mg of active principle.

19. Composition according to Claim 18 in which each dose unit contains from 0.5 to 50 mg of active principle.

20. Pharmaceutical composition containing a polysaccharide or salt according to Claims 1 to 14 in combination with another antithrombotic or anticoagulant active principle, platelet aggregation inhibitor or antagonist of the glycoprotein IIb/IIIa complex.

21. Pharmaceutical composition according to Claim 20 characterized in that the combined active principle is dipyridamole, aspirin, ticlopidine or clopidogrel.

22. Use of the polysaccharides and salts according to Claims 1 to 14 for the preparation of a medicine useful in pathologies dependant on a coagulation dysfunction.

23. Use of the polysaccharides and salts according to Claims 1 to 14 for the preparation of a medicine useful for the inhibition of growth factors which is shown by an inhibition of cell proliferation.

24. Use of the polysaccharides and salts according to Claims 1 to 14 for the preparation of a medicine having antiviral, hypolipidaemic, anti-free radical, antimetastatic, antiangiogenic or anti-inflammatory properties.

Sub Q2

add Q3